BIOLOGY AND IMMATURE STAGES OF *DECTES SAYI* DILLON AND DILLON (COLEOPTERA: CERAMBYCIDAE)[1]

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ABSTRACT

The life cycle of *Dectes sayi* Dillon and Dillon, a cerambycid associate of common ragweed, *Ambrosia artemisiifolia* L., is discussed. Adults began appearing in early July with peak populations emerging in mid-August. Eggs are deposited singly in the pith of primary and secondary stems. First to fourth instars bore into and feed upon the pith from late July to late October. Mature or nearly mature larvae overwinter in a diapause state within a specially prepared chamber located in the rootcrown area of the stem. Pupation occurred during mid-summer within the chamber. The beetle is univoltine in northeastern Ohio. Diagnostic descriptions and/or illustrations of the immature stages are provided.

INTRODUCTION

Recently, increased emphasis has been placed on the development of biological control programs against several of the ragweeds (*Ambrosia* spp.: Compositae) found in North America and in certain areas of Eurasia (Harris and Piper 1970, Goeden *et al.* 1974, Goeden and Ricker 1976c). Surveys of the entomofaunas of selected ragweeds have revealed a diverse assemblage of insects, many of which are poorly known biologically (Hack 1935, Goeden and Ricker 1974a, b, 1975, 1976a, b, c). The paucity of detailed biological and ecological information on *Ambrosia* insects, particularly the Coleoptera, has prompted recent investigations (Piper 1975, 1977a, b, 1978a, b, Welch 1978).

In northeastern Ohio, common ragweed, *A. artemisiifolia* L., supports a variety of phytophagous Coleoptera. One such associate is the cerambycid, *Dectes sayi* Dillon and Dillon. Since little was known about the life history and immature stages of this beetle, the present study was initiated.

In North America, the genus *Dectes* LeConte contains two broadly distributed species, *D. sayi* and *D. texanus* LeConte. Four subspecies of *D. texanus* also have been recorded from the southwestern United States (Dillon 1956). The biology of *D. texanus* has been reported upon by Hatchett *et al.* (1973), Patrick (1973), Hatchett *et al.* (1975), and Rogers (1977). Its host plants include soybean *(Glycine max* [L.] Merr.), sunflower (*Helianthus annuus* L.), crested anoda (*Anoda cristata* [L.] Schlecht.), cocklebur (*Xanthium pensylvanicum* Wallr.), cowpea (*Vigna unguiculata* [L.] Walp.), and ragweed (*A. artemisiifolia* and *A. trifida* L.). *D. sayi* larval feeding is restricted to species of *Ambrosia* (Beutenmüller 1896, Leng and Hamilton 1896, Blatchley 1910), *Eupatorium* (Craighead 1923), *Helianthus* (Beckham

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and Tippins 1972), and *Xanthium* (Craighead 1923). Larval, pupal, and adult descriptions and/or illustrations have been provided by Craighead (1923), Knull (1946), and Peterson (1951).

Field observations on the biology of *D. sayi* were made in or near the city of Kent (Portage County) in northeastern Ohio. Adults either were hand-picked or swept from ragweed plants. Stems were dissected to obtain eggs, larvae, and pupae. Laboratory rearings were maintained at room temperatures of 20°-25°C, 50%-60% RH, and a 12:12 hr L:D regime.

Life History

Dectes sayi is distributed from New York, south to Alabama, and west to North Dakota (Dillon 1956). Adults are 6.0-10.5 mm long and 2.0-2.8 mm wide, cylindrical, dark-reddish brown to black, and uniformly covered with a dense cinereus pubescence. Dillon (1956) provided detailed adult descriptions of *D. sayi* and *D. texanus* and noted interspecific diagnostic characteristics.

Adult emergence began during early July and essentially was completed by mid-September. Peak populations were found during mid-August. Laboratory-reared adults lived an average of 27 (range 21-35) days, with females generally outliving males. No males were collected in nature after the first week of September. Sex ratio was determined by examining 72 adults which emerged from field-collected pupae. The male:female ratio was 1:1. There was only 1 generation annually in northeastern Ohio, although Hack (1935) noted 2 generations/yr in Kansas.

Adults generally remained closely associated with *A. artemisiifolia,* seldom being observed on other vegetation. The beetles were most active during the morning and early evening hours and were usually positioned head downward in leaf axils near the plant apex. If approached or molested while on the plant, *D. sayi* adults either flew away, dropped to the soil and feigned death, or remained on the plant and stridulated. Both sexes fed upon the epidermis and underlying parenchyma of ragweed stems and leaf petioles. The feeding activity did not result in any discernible plant injury.

The premating period was not determined. Mating was observed most frequently in nature during the late morning and early afternoon on the upper third of the host plant. No ritualistic courtship behavior was noted for *D. sayi.* The male mounted the female from behind by moving directly forward and onto her dorsum. His front tarsi clasped her humeri and the middle tarsi grasped either her hind coxae or femora. The male's hind legs rested upon the plant. The male's extruded aedeagus was directed anteroventrally until coupling with the female's genitalia was achieved. Although the female generally remained passive during copulation, periods of restlessness were observed occasionally. The male attempted to pacify the restless female by appressing his mandibles and/or maxillary palpi to her scutellum. Genitalia disengagement and re-engagement often occurred during mating but the male did not dismount until insemination of the female was accomplished. The male terminated copulation by moving backward, thereby separating the joined genitalia. Copulation lasted anywhere from 15-45 min. Repeated matings between the same male and female occurred frequently in the laboratory prior to the first oviposition. It was not determined if a male was capable of mating with different females or if a mated female was receptive to other males.

The preoviposition period of 4 females averaged 16 (range 14-18) days. These females each deposited an average of 3 (range 0-5) eggs/day over a 15 day period. Total eggs produced/female ranged from 20-46, the average being 32.

In nature, oviposition was restricted to the late afternoon and evening hours. In large stands of ragweed, peripherally located plants whose primary stem diameters exceeded 7.0 mm were selected more frequently for oviposition purposes than were smaller, narrower-stemmed plants growing in the central area of the stand. A female chose a suitable oviposition site on the apical third of either a primary or secondary stem, usually at the base of a leaf petiole. She positioned her body parallel to the stem with the head directed upward and proceeded to chew a hole through the stem epidermis and cortex. After preparing the egg niche, the female advanced up the stem until the tip of her abdomen was positioned above the excavation. She probed for the aperture with her ovipositor and, upon its location, inserted the ovipositor and deposited a single egg in the pith. The average time for preparation of the egg niche and for oviposition (15 observations) was ca. 7 min and 3 min, respectively. The incubation period of 20 eggs held under laboratory conditions averaged 5 (range 4-7) days. Viability of laboratory-laid eggs was 70%.

The first instar of *D. sayi* is provided with thoraco-abdominal hatching spines (Gardiner 1966). A larva simultaneously ruptured both sides of the chorion with its spines, enlarged the slits thru peristaltic movement, and then emerged.

Upon hatching, the larva fed upon the pith around the oviposition cavity for several days but then bored into the pith of the stem. Second, third, and fourth instars tunneled the length of the internodes and consumed almost all of the pith. The length of the larval gallery ranged from 15.0-75.0 cm, the length being governed by plant height. Although larval tunneling structurally weakened the stem and facilitated mechanical breakage, plant mortality solely attributable to larval feeding was never observed in the field. The larval stadia were as follows: first, 6 (range 4-9) days; second, 12 (range 10-14) days; third, 14 (range 13-18) days; fourth, under laboratory conditions only, 16 (range 12-20) days.

D. sayi larvae are cannibalistic. Although a female occasionally deposited eggs in both primary and secondary stems of the same plant, only a single larva per plant reached maturity.

During October and November, the mature or nearly mature larva descended into the root and prepared a chamber utilized both for overwintering and pupation. The larva girdled the primary stem 5.0-8.0 cm above ground level and sealed the section of the gallery below the girdle with a 2.5-7.5 cm long plug of tightly packed powdery frass. The portion of the plant above the girdle lodged and the larva overwintered in the root or root crown area in a diapause state (Fig. 1).

Resumption of larval activity occurred during late April and early May. A partially grown larva completed its development by feeding upon the vascular and cortical tissues of the root.

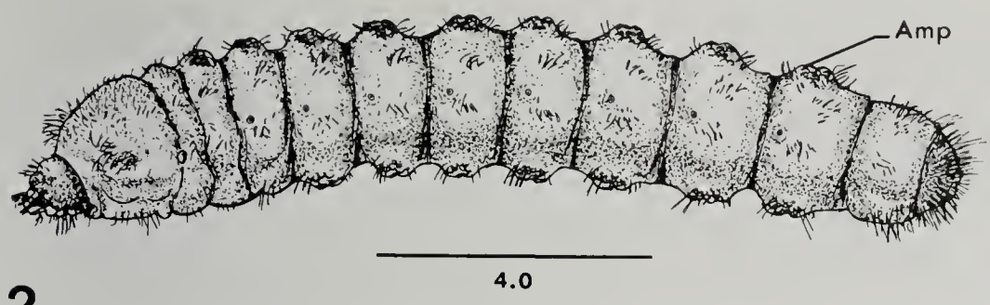
Pupation began in late June and continued into early August. In nature, a larva always pupated head upward within the chamber. The pupal stadium under laboratory conditions was 12 (range 10-14) days. After the teneral adult becomes sufficiently sclerotized it gnaws a hole through the fragile, necrotic stem wall and emerges.

Descriptions of Immature Stages

Egg. (Fig. 6). Length 1.65-1.98 mm, maximum width 0.39-0.46 mm (20 specimens). Lemon-yellow, shining. Elongate, arcuate dorsally, tapering toward the ends, ends rounded. Chorion smooth, devoid of sculpturing. Micropyle located terminally.

First Instar. Terminology of larval characters follows Duffy (1953). Similar to fourth instar except in following characters. Length 1.65-1.98 mm, head capsule width 0.39-0.46 mm (20 specimens). Color creamy white to yellow. All cephalic, thoracic, and abdominal setae longer in proportion to those of later instars. Integument of pro-, meso-, and metathorax and abdominal segments 1-8 asperate. Head somewhat exserted; maxillae and labium weakly sclerotized; segment 2 of labial palpi longer than 1. Clypeus twice as long as wide; labrum protuberant. Hypostomal sutures

Fig. 1. Overwintering and pupal cell of *D. sayi* (arrow indicates usual position of larva or pupa within cell).



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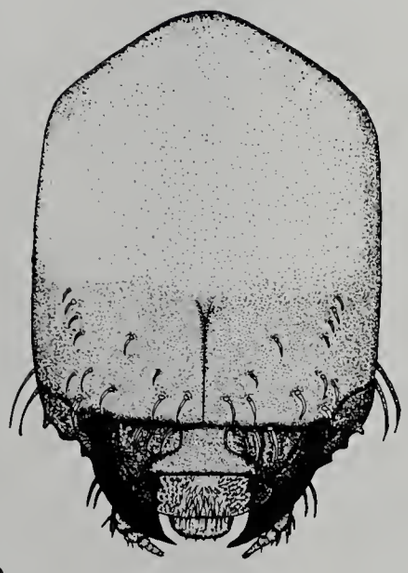

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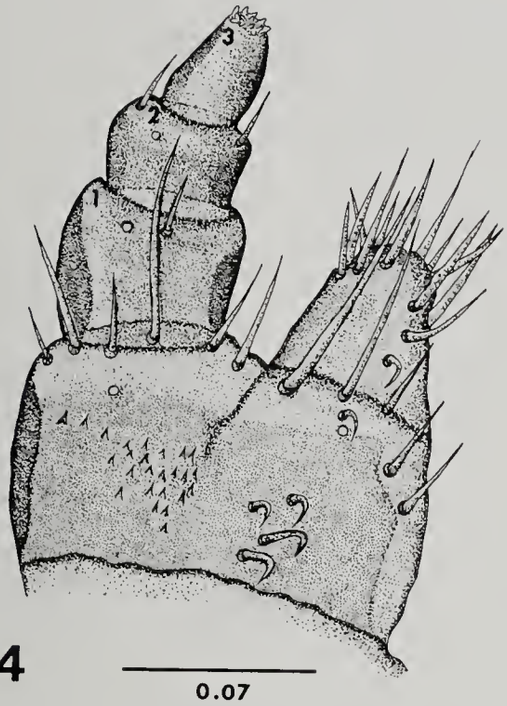

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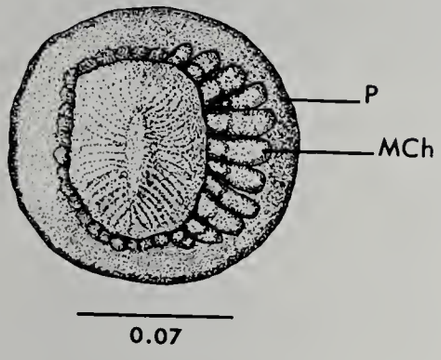

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Figs. 2-7. *Dectes sayi,* fourth instar and egg. 2) Lateral habitus. 3) Head capsule, frontal view. 4) Right maxilla, ventral view. 5) Abdominal spiracle. 6) Egg. 7) Right mandible, ental view. All measurements indicated by scale lines are in millimeters. Amp, ampulla; Mch, marginal chamber; Mp, micropyle; P, peritreme.

indistinct. Ambulatory ampullae poorly developed. Mesothorax, metathorax, and abdominal segments 1-8 with sclerotized hatching spines ventrad and posterad spiracles; spines short, bluntly triangular. Spiracles biforous.

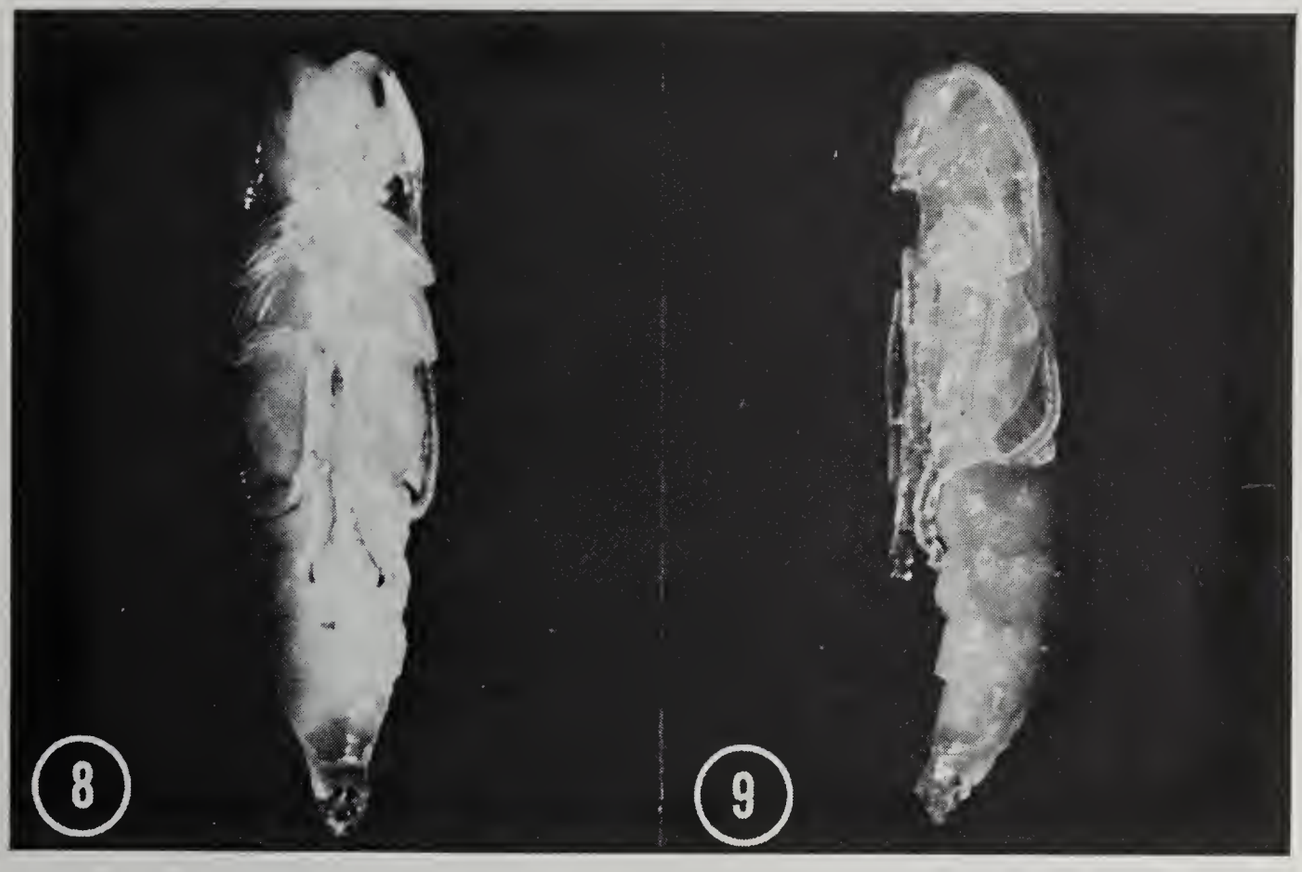
Second Instar. Similar to fourth instar except in following characters. Length 3.12-4.57 mm, head capsule width 0.49-0.81 mm (20 specimens). Spiracles orbicular with marginal chambers.

Third Instar. Similar to fourth instar except in following characters. Length 5.23-11.2 mm, head capsule width 0.92-1.19 mm (20 specimens).

Fourth Instar. (Fig. 2). Length 12.0-15.0 mm, head capsule width 1.22-1.44 mm. Color milky white, shining; integument thin; sparsely clothed with fine white setae. Form elongate, slightly curved and cylindrical. Head strongly depressed, deeply retracted into prothorax; mouthframe strongly sclerotized. Mid-cranial sulcus distinct (Fig. 3), pair of short setae on both sides of sulcus; anterior margin of frons with transverse row of 6 setae, lateral margin with longitudinal row of 7 setae; epistoma with row of 6 setae. Genae rounded with conspicuous transverse furrow immediately in front of each ocellus. Ocellus ventrad antenna, pigmented eyespot distinct; 1 seta dorsad, 2 setae ventrad each ocellus. Hypostoma flat, slightly wrinkled, sutures ferruginous and curved. Gular region with a pale ventral cleavage line, on each side of which is a rugose area bearing 3 setae. Antennae 2-segmented; segment 2 bearing a supplementary process. Clypeus distinct; trapezoidal, 4 times as long as wide; glabrous. Labrum thick, anterior portion fringed with numerous short, bristly setae. Mandibles (Fig. 7) shiny black, short, not noticeably divided into basal and distal portions, the latter strongly curved and acute; 2 setae on ectal surface near bases. Maxillary palpi (Fig. 4) 3-segmented, segment 3 longer than 2, equivalent to 1. Ventral surface of segments 1 and 2 each with 1 sensillum placodeum; tip of segment 3 invested with 10-11 sensilla basiconica. Maxillary lobes setose. Labial palpi 2-segmented, segment 1 equal to 2; tip of 2 with 8-9 sensilla basiconica. Ligula heavily setose; mentum distinct from submentum. Prothorax thick; pronotum rectangular, delimited by lateral furrows; transverse row of setae just behind anterior margin; posterior half of pronotum with 2 ferruginous areas of very fine, dense asperities with numerous interspaced glabrous spots. Prosternum shining, setose; eusternum indistinct; sternellum distinct, smooth, and shining except for 2 groups of 5 setae ventrad and laterad transverse furrow. Mesonotum smooth, with transverse row of setae; metanotum with ampulla. Mesosternum and metasternum with setose ampullae. Legless. Abdominal segments elongate, cylindrical; dorsal and ventral ampullae located on segments 1-7; extremely protuberant. Dorsal ampullae (Fig. 2) divided by a deep longitudinal median furrow, laterally tuberculate in 2 distinct rows; ventral ampullae tuberculate with shallow transverse furrow; not divided into 2 distinct rows. Epipleuron slightly raised on segments 1-6, strongly protuberant on segments 7-9; pleural tubercles broadly oval, distinct on segments 1-9; each with a posterodorsal and anteroventral sclerotized pit and bearing 3 setae. Anal segment sparsely fringed with long setae; protuberant; trilobate, one lobe dorsad and others lateroventral to anus. Spiracles (Fig. 5) small, orbicular; bilabiate with respiratory opening narrow; feebly sclerotized peritremes, posterior margin of peritreme with 8-10 marginal chambers. Paired spiracles located on mesothorax and abdominal segments 1-8; mesothoracic spiracle largest.

Pupa. (Fig. 8, 9). Terminology of pupal characters follows Duffy (1953). Length 8.3-12.2 mm (30 specimens). Body closely resembling form of adult in size, shape, and proportions of cephalic and thoracic appendages; exarate; color waxy yellow to cream when newly formed. Head with vertex visible from above, deeply excavated between antennae; glabrous. Rims of antennal sockets bearing 3 long setae; frons with 2 setae below antennal bases, a pair ventrad those, 2 setae laterad each ocellus. Clypeolabrum triangular; arcuate row of 6 setae across upper portion of clypeus; labrum with 4 setae. Antennae thick at basal end; arising anterior to eyes, extending to abdominal segment 4 where they are curved downward and directed anteriorly, finally terminating near the mid-coxae. Eyes slightly convex, glabrous. Mandibles with 2 setae near middle of ectal surface. Pronotum with straight sides diverging posteriorly to prominent lateral tubercles, each with several long setae; pronotum beset with numerous small spines, each bearing a basal seta. Mesonotum smooth; scutellum protuberant, glabrous; anterior margin of mesopleuron with a large, oval spiracle. Metanotum smooth; several fine setae on each side of scutellar groove. Elytra and wings extending to anterior margin of abdominal sternite 4. Abdomen with tergites 1-6 protuberant; terga, except first, armed with median groups of slightly curved, chitinized spines which, in general, become progressively larger and more

numerous posterad; each spine with a basal seta; transverse glabrous band on each tergum. Tergite 7 tapering posterad, hind margin rounded; armed with an anterior group of small spines, a median row of large spines, and a posterior group of still larger spines. Tergite 8 slightly inflated, bearing 6-8 small spines near posterior margin. Tergite 9 visible from above, bearing 2 spines. Sterna glabrous and unarmed, except 8 which bears several setae; sternite 9 with a pair of tubercles. Legs with 3 long setae near apex of each femur; hind femora extending to abdominal segment 3; tibiae directed posterad. Functional spiracles present on segments 1-6; peritreme broadly oval, thick, raised above general level of cuticle; marginal chambers present.



Figs. 8-9. *Dectes sayi,* pupa. 8) Ventral view. 9) Lateral view.

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